methods (bypass 2.9 ± 0.9 cm vs stent graft 3.1 ± 1.0 cm, $P = .5$). Primary patency at 1 and 3 years was 82% and 82% for bypass and 66% and 44% for stent graft, respectively ($P = .08$). Predictors of loss of primary patency were stent graft (odds ratio [OR], 6.5; $P < .05$) and fewer patent outflow vessels (OR, 3.0; $P < .05$). Secondary patency at 1 and 3 years was 95% and 89% after bypass vs 100% after stent grafting ($P = .2$; Fig). Hypertension was protective (OR, 0.4; $P < .05$). No patient required amputation. Survival at 3 years was similar at 82% after bypass and 89% after stent grafting ($P = .94$). Mean length of stay was longer after bypass (3.6 ± 3.8 vs 1.1 ± 0.5 days, $P < .01$).

Conclusions: Although primary patency seems to be worse after stent graft exclusion of popliteal aneurysms, reinterventions are commonly successful and result in an excellent secondary patency rate. Older patients with limited survival may benefit from stent grafting, whereas patients with limited outflow may benefit from bypass.

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Pedal Vessel Access and Endovascular Retrograde Revascularization for Complex Tibial Vessel Disease◇

Uwe Fischer, Marie Unruh, Mark Davies, Hosam El-Sayed. Houston Methodist Hospital, Houston, Tex

Objective(s): Endovascular revascularization is an established approach for limb salvage in the setting of critical limb ischemia. However, failure rate of anterograde recanalization in complex femoropopliteal to infrapopliteal occlusions is as high as 20%. We report a series of 19 patients who underwent transpedal access retrograde recanalization of below-the-knee chronic total occlusions after a failed anterograde attempt.

Methods: Between 2011 and 2014, 19 patients (15 men, 4 women), aged 68 ± 12 years, underwent percutaneous pedal access for retrograde endovascular treatment of advanced tibial vessel disease. All patients had undergone prior unsuccessful attempts of antegrade revascularization. Pedal vessel access was followed by angioplasty or stenting, or both, and completion angiogram. Patients were followed up with duplex ultrasound imaging to evaluate for patency.

Results: Retrograde pedal access was successful in all patients (dorsalis pedis, n = 11; posterior tibial, n = 5; anterior tibial, n = 3). Retrograde revascularization was achieved in 12 patients (63%) using balloon angioplasty (n = 12) and balloon angioplasty with stent placement (n = 1). Revascularization failed in seven patients (37%). Vessels revascularized included the posterior tibial (n = 3), anterior tibial (n = 3), dorsalis pedis (n = 8), and the popliteal artery (n = 3). Duplex ultrasound imaging at 2 and 6 months postoperative showed vessel patency. There were no in hospital adverse events.

Conclusions: Pedal vessel access for retrograde angioplasty with or without stent placement is a feasible option and enhances endovascular options for revascularization in complex below-the-knee vessel disease with good results.

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Indications for Readmission After Lower Extremity Bypass in the National Surgical Quality Improvement Project†

Sarah J. Carlson, Thomas Curran, John C. McCallum, Dominique B. Buck, Jeremy Darling, Allen D. Hamdan, Raul J. Guzman, Marc L. Schermerhorn. Beth Israel Deaconess Medical Center, Boston, Mass

Objectives: Readmission after lower extremity bypass (LEBP) is common, yet the indication for readmission and its relationship to reoperation has not been well described. We used the newly available National Surgical Quality Improvement Project (NSQIP) parameters to evaluate unplanned readmission ≤30 days of LEBP.

Methods: All patients undergoing LEBP in the 2012 NSQIP were identified. Indications for 30-day reoperation and readmission were identified. Independent predictors of readmission were determined using logistic regression. Unplanned readmission was defined as a readmission not planned at time of index procedure.

Results: We identified 5375 cases. A total of 858 (16%) underwent readmission, and 821 (15%) were unplanned readmissions. Incisional surgical site infection (SSI) was the most common indication for readmission (36%), followed by wound disruption (13%), and non-SSI wound-related complications (14%), including cellulitis (5%), gangrene/tissue loss (5%), hematoma (3%), and seroma (2%). On multivariable analysis (Table), predischarge urinary tract infection was the most significant predictor of unplanned readmission (odds ratio [OR], 5.4) followed by predischarge SSI (OR, 3.7), graft failure (OR, 2.5), and wound debridement (OR, 2.1). Amputation before discharge was not predictive of readmission (OR, 1.1; 95% confidence interval, 0.7-1.6). Among patients who were readmitted, 106 (13%) underwent amputation, with 55 (7%) minor (toe or partial foot), and 51 (6%) major (above-knee or below-knee). A total of 536 patients underwent predischarge reoperations (65%), most commonly for graft revision (31%), wound debridement (21%), and amputation (minor, 21%; major, 12%). A total of 413 patients underwent postdischarge reoperations (50%), most commonly for wound debridement (38%), graft revision (23%), and amputation (minor, 13%; major, 12%; Table).

Table. Factors predictive of unplanned readmission after lower extremity bypass (LEBP)

Predictive factors	*OR*	*95% CI*	P
Predischarge			
Urinary tract infection	5.39	1.32-21.97	.019
Surgical site infection	3.73	1.09-12.81	.037
Graft failure	2.51	1.07-5.89	.035
Wound debridement	2.10	1.35-3.27	.001
Transfusion	1.36	1.14-1.62	.001
Dialysis dependence	1.65	1.25-2.17	0
Emergency index surgery	1.41	1.02-1.95	.04
Preoperative foot infection	1.28	1.08-1.51	.004
Body mass index >30 kg/m^2	1.25	1.06-1.47	.009
Distal bypass (infrapopliteal target)	1.25	1.06-1.46	.006
Diabetes	1.25	1.06-1.46	.007
Elective index surgery	1.24	1.04-1.48	.015
Bleeding disorder/anticoagulation	1.21	1.02-1.43	.031
Postoperative length of stay	0.98	0.96-0.99	.008

CI, Confidence interval; *OR*, odds ratio.

Conclusions: This is the first review of data on LEBP patients from a national database that includes information on the indication for readmission and specific reoperation. Although wound debridement is predictive of unplanned readmission, amputation is not. The prior iterations of NSQIP have underestimated the number of wound-related complications leading to readmission. These data may suggest a role for increased outpatient wound surveillance and early outpatient intervention for wound-related complications, when possible, to prevent the need for unplanned readmission.

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A Prospective Study of Human Viable Wound Matrix in the Management of Chronic Venous Ulcers◇

Shahab Toursavadkohi, Rishi Kundi, Gregory Kowalewski, Thomas S. Monahan, Rosemary Smith-MaMacchia, Marlene Binnick, Rajabrata Sarkar, Brajesh K. Lal. University of Maryland School of Medicine, Baltimore, Md

Objectives: Treatment of chronic venous ulcers (CVU) is difficult and resource-intensive, with reported healing rates of 20% to 50% with local wound care and compression. Human viable wound matrix (HVWM) contains extracellular matrix, growth factors, and several viable cells, including mesenchymal stem cells. In this study, we compared healing characteristics of CVU treated with HVWM vs standard of care.

Methods: This prospective single-center trial included patients with duplex ultrasound confirmed CVU of at least 12-weeks' duration that had failed standard care for at least 6 weeks. Patients with active infections and ischemia (ankle-brachial index <0.8) were excluded. All patients received standard multilayer compression bandages and local wound care. Half the patients also received HVWM applications once every 1 to 2 weeks for 6 weeks. The primary outcome was the proportion of completely healed wounds (ulcer healing rate). The secondary outcome was the percentage change in total ulcer surface area during 6 weeks of follow-up.

Results: All 20 patients enrolled were men; mean age was 68 years. Duplex ultrasound imaging confirmed superficial, or a mixture of superficial

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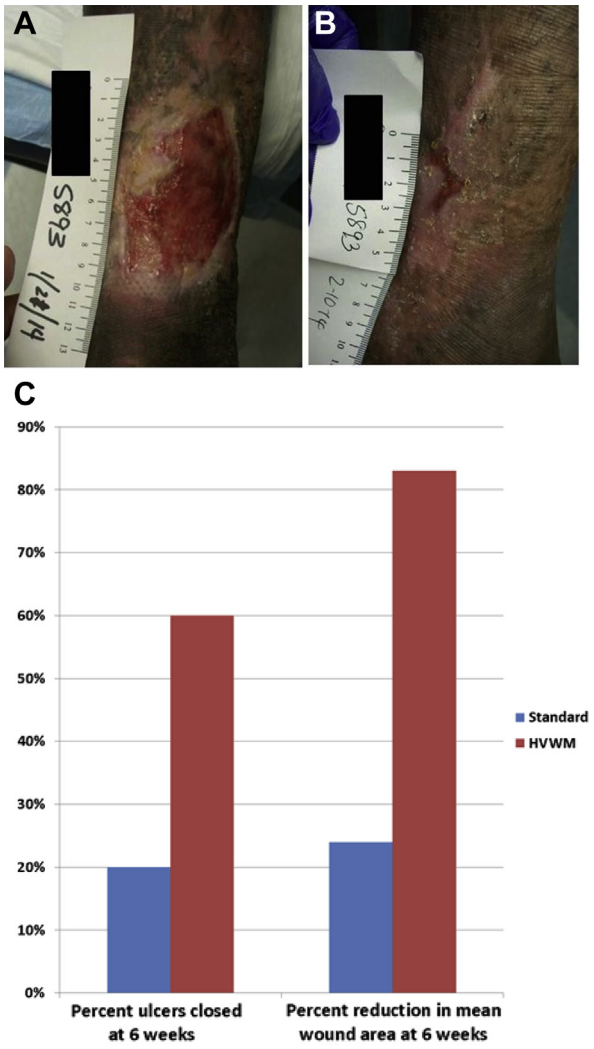

Fig. A, Venous ulcer. **B,** Healed ulcer after applications of human viable wound matrix (*HVWM*). **C,** Healing rates versus compression alone.

plus deep system, reflux in all patients. The ulcer had been present for a mean of 10.8 months in these patients (Fig, *A* and *B*). The ulcer-healing rate was 60% in the HVWM group (n = 10 limbs) and 20% in the standard-care group (n = 10 limbs; $P < .05$). The percentage change in total surface area after 6 weeks of treatment was 83.2% in the HVWM group vs 24.7% in the standard-care group ($P < .05$; Fig, *C*).

Conclusions: Patients with chronic venous ulcers treated with a product that delivers viable mesenchymal stem cells directly to the wound achieved superior healing rates over standard treatment alone. Larger trials will be required to confirm these early findings.

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Mortality Can Be Reduced in Infrainguinal Reconstruction Even With an Aggressive Open Surgical Approach in the Endovascular Era: The Benefits of a Standardized Approach and Regionalization of Care†

R. Clement Darling III, Philip S. K. Paty, Sean P. Roddy, Benjamin B. Chang, Paul B. Kreienberg, Kathleen J. Ozsvath, John B. Taggert, Yaron Sternbach. Albany Medical College, Albany, NY

Objectives: Distal revascularization has undergone a transformation during the last 25 years. With the improvement of endovascular technology and antiplatelet therapy, many have adopted an aggressive endovascular approach using open reconstruction sparingly, partially because of the perception of significant mortality and morbidity after open procedures. During the past 5 years, our group has used a balanced standardized approach to distal revascularization, using primary open reconstruction for patients with significant foot necrosis, deep space infection, and any adequate venous conduit. We have also developed a comprehensive network to transfer patients who need complex reconstructions to a tertiary center for more definitive care.

Methods: Data were prospectively collected from our vascular registry. Patient demographics, type of procedure, mortality, morbidity, and limb salvage were recorded. We compared results from 2003 to 2008 (group A) with results from 2008 to 2013 (group B). In 2008, we adopted a standardized approach in our practice for patients presenting with significant peripheral vascular disease.

Results: From 2003 to 2008, our group performed 2996 infrainguinal reconstructions (2309 open bypass and 687 endovascular). Operative mortality was 2.84% (3.33% open, 1.16% endovascular). From 2008 to 2013, 4321 infrainguinal reconstructions were performed (2314 open, 2007 endovascular). Total mortality was 1.25% (1.94% open, 0.9% endovascular). The differences were statistically significant. Limb salvage and major complications were similar and not significant.

Conclusions: Standardization of indications and procedures and appropriate transfer of complex patients to a dedicated center can reduce mortality of patients undergoing infrainguinal reconstruction while maintaining quality outcomes.

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Long-Term Follow-Up After EVAR: A Contemporary Series†

Clayton J. Brinster, Matthew R. Cambria, Emel A. Ergul, Mark F. Conrad, Richard P. Cambria. Massachusetts General Hospital, Boston, Mass

Objectives: This study was designed to examine the long-term outcomes after endovascular aneurysm repair (EVAR).

Methods: All clinical preoperative, operative, postoperative, and follow-up data of patients undergoing EVAR between 2008 and 2012 were collected prospectively and examined retrospectively. Presence of endoleak, need for secondary intervention, and survival were analyzed.

Results: A total of 464 patients underwent EVAR with approved devices. The average age was 78.9 ± 8.0 years, and 379 (82%) were men. Urgent or emergency EVAR was performed in 32 patients (7.1%). The 30-day mortality was 2.4%. During an average follow-up of 45.4 ± 19.1 months, the relative survival was 62% by Kaplan-Meier analysis. Endoleak developed in 83 patients (18%): 13 type I (3%), 67 type II (14%), and 2 type III (0.4%). The average time to detection of endoleak was 17 months (range, 3-54 months), and 27 endoleaks (33%) were detected after the first postoperative computed tomography scan. Spontaneous resolution of type II endoleak was observed in 40 patients (59%). A total of 57 secondary interventions were required in 44 patients (9.5%). Indications for reintervention included type I endoleak in 15 (26%), type II endoleak with sac expansion >5 mm in 30 (53%), limb kinking or thrombosis in 10 (18%), and renal artery stenosis in 2 (3.5%). Initial secondary intervention was successful in 35 patients (80%). Freedom from reintervention was 95% at 1 year and 90% at 5 years, and the average time to reintervention was 20.5 ± 8.3 months. Preoperative sac size, current systemic anticoagulation, and history of smoking, diabetes, or hyperlipidemia did not predict development of endoleak or need for reintervention.

Conclusions: Despite overall favorable results in this contemporary series, the rate of required secondary intervention at an average of nearly 2 years postprocedure is unchanged from previous reports. The range of time to initial presentation of endoleak underscores the continued need for long-term clinical and radiologic surveillance.

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